# Scope of Work and Schedule

# Alternative Cover Designs

## Introduction

In an October 12, 2012 letter, EPA Region 7 asked that, as part of a Supplement to the Supplemental Feasibility Study [SFS] (EMSI, 2011), the Respondents evaluate potential alternative landfill cover designs including but not limited to an Evapo-Transpiration (ET) Cover for Operable Unit-1 (OU-1) of the West Lake Landfill. EPA had previously indicated that the National Remedy Review Board wanted the use of synthetic cover materials evaluated as part of the Supplemental SFS. This work plan presents a scope of work for evaluation of the potential application of an ET cover and for the potential application of an alternative cover that would incorporate a synthetic material layer, specifically a geosynthetic clay liner (GCL), into the design of the landfill cover for OU-1.

## Background

ROD-Selected Remedy Landfill Cover

The remedy selected in EPA's Record of Decision (ROD) for OU-1 (the ROD-selected remedy) includes an enhanced Resource Conservation and Recovery Act (RCRA) Subtitle D (solid waste) cover system to be installed and maintained over Radiological Areas 1 and 2 (EPA, 2008). This cover system would at a minimum be designed to meet the design requirements for final cover systems at municipal solid waste landfills (MSWLF) and the Missouri closure and post-closure requirements for sanitary landfills, with additional enhancements consistent with standards for uranium mill tailings sites (i.e., armoring layer, protection against gamma radiation, and radon barrier). Specifically, the design of the landfill cover under the ROD-selected remedy is anticipated to consist of the following layers (from top to bottom):

- A one-foot thick layer of soil capable of sustaining vegetative growth;
- A two-foot thick infiltration layer of compacted USCS CL, CH, ML, MH, or SC soil-type with a coefficient of permeability of $1 \times 10^{-5}$ cm/sec or less; and
- A two foot thick bio-intrusion/marker layer consisting of well-graded rock or concrete/asphaltic concrete rubble.

Such a cover system includes a low conductivity barrier layer, in this case the two foot thick infiltration layer described above, to minimize percolation of rainfall or snowmelt through the cover from entering the underlying waste materials.



WLLFOIA4312 - 011 - 0136044

Evapotranspiration Cover

In contrast, ET cover systems are designed to rely on the ability of the soil layer in the landfill cover to store the precipitation until it is naturally evaporated or transpired by the vegetative cover (EPA, 2011). ET cover systems rely on the appropriate water storage capacity of the soil layer and, in wetter climates, vegetation that can remove percolation rather than relying on an engineered low hydraulic conductivity barrier layer to prevent percolation from entering the underlying waste materials.

As described by EPA (2011), "ET cover systems are generally considered more applicable in areas that have arid or semi-arid climates like those found in parts of the Great Plains and West (e.g., North and South Dakota, Montana, Idaho, eastern Washington and Oregon, Utah, Colorado, West Texas, New Mexico, Arizona, Nevada, and southern California). Albright and Benson (2005) in their examination of data generated in EPA's Alternative Cover Assessment Program (ACAP) found: "In humid locations with the abundant precipitation and typically lower potential evapotranspiration, the store-and-release mechanism used by ET covers does not provide sufficient hydraulic control to match the performance of *conventional composite covers*. (emphasis added) However, the ACAP field data did show that in humid locations properly designed ET covers can provide performance comparable to that of the *compacted clay covers* in those locations" (EPA, 2011).

Review of sites contained in EPA's alternative cover database http://cluin.org/products/altcovers/ indicates that only two alternative cover designs have been documented in Missouri; one is a demonstration project installed in 1995 for an inactive fly ash waste pond at a power plant and the other is an ET cover constructed in 2003 over contaminated soil at a former wood treating plant. In the first case, it was determined that the ET cover did not successfully manage precipitation that fell on the inactive ash pond. No information was available regarding the long term performance of the ET cover installed at the second site listed in the EPA database. No Missouri sanitary landfills with ET covers have been identified.

Landfill Cover Incorporating a Geosynthetic Layer

There are several types of geosynthetic products that are often used in landfill containment design that could be considered for alternate landfill cover designs to the soil-only landfill cover prescribed in the ROD remedy. For example, geomembranes or GCLs are often used as low-permeability components, and geonets and geotextiles are often used as drainage layers. For this evaluation, the use of a GCL will be evaluated. A GCL is a synthetic product composed of a core layer of natural low-permeability bentonite clay sandwiched between geotextile fabric. With its low permeability, a GCL may have the potential to be used as a substitute for all or part of the infiltration layer, and still achieve the objective of minimizing percolation through the cover. Selection of a GCL as the representative process option for the evaluation of an alternative cover using synthetic materials was based on the reliance of GCL on the presence of bentonitic clay for achieving low permeability. Being a natural material, bentonite is expected to offer significant advantages over plastic-only based geomembranes in terms of longevity and durability.



WLLFOIA4312 - 011 - 0136045

**Approach**

The potential implementability of alternative landfill cover designs for Areas 1 and 2 will be evaluated in the same manner that the potential applicability of other technologies are evaluated in the SFS. Specifically, an initial technical implementability screening evaluation will be performed to assess the potential applicability of the alternative landfill cover designs. If the initial screening indicates that one or both of the alternative landfill cover designs are potentially applicable to OU-1, these technologies would then be subjected to further evaluation of their potential effectiveness, implementability and cost. During this phase, the anticipated performance of the alternative landfill cover designs would be compared to that of the cover specified in the ROD-selected remedy. If these evaluations indicate that one or both of the alternative landfill cover designs could provide similar effectiveness at minimizing infiltration at comparable cost, then a recommendation for consideration of use of an alternative landfill cover design would be made.

Evapotranspiration Cover Design

The initial screening of the potential implementability of an ET cover will evaluate the thickness of the soil cover that would be required to prevent percolation of precipitation from reaching the underlying waste materials. This evaluation will be based on an assumption that a capillary barrier type ET cover consisting of a surface vegetated with native plants, a fine-grained layer (appropriate thickness to-be - determined by the evaluation) consisting of clay and/or silt soil for storage of infiltration, and a coarse-grained, biointrusion/marker/capillary break layer consisting of two feet of well-graded rock or concrete/asphaltic concrete rubble would be installed over Areas 1 and 2. Modeling of the anticipated infiltration rate would be performed for a variety of thicknesses for the fine-grained layer beginning with a 2-foot thick layer and progressively increasing in thickness with the goal of identifying the required theoretical layer thickness necessary to prevent or minimize infiltration into the underlying waste mass. Modeling of the anticipated cover thickness would be performed using the UNSAT-H model (Fayer, 2000) or HYDRUS-1D (Šimůnek,et al., 2005).

If the technical implementability screening indicates that infiltration of precipitation can be minimized with an ET cover employing a fine-grained layer 5-feet thick or less, then this technology would be considered potentially implementable and would be subjected to further evaluation of its potential effectiveness, implementability and cost. During this phase, the anticipated performance of an ET cover would be compared to that of the cover specified in the ROD-selected remedy. If these evaluations indicate that an ET cover could provide similar effectiveness at minimizing infiltration at comparable cost, then a recommendation for consideration of use of an ET cover would be made.

Geosynthetic Clay Liner Cover Design

An initial technical screening will be performed to assess the potential implementability of an alternative landfill cover design that incorporates a GCL liner into the landfill cover design specified under the ROD-Selected Remedy (hereafter referred to as the "GCL-alternate cover"). Because use of GCLs in cover systems is a generally accepted technology for landfills, the primary focus of this evaluation will be the anticipated design life of a GCL layer relative to the longevity criteria that have previously been



WLLFOIA4312 - 011 - 0136046

identified as potentially relevant and appropriate requirements under the Uranium Mill Tailings Radiation Control Act regulations for the landfill cover. The initial implementability screening evaluation will also consider site-specific factors that could affect the implementability of a GCL-alternate cover. Specifically, the potential effects of a GCL-alternate cover on the overall stability of the final landfill slopes will be evaluated. In addition, the need for inclusion of additional soil material to allow for installation and incorporation of a GCL in the landfill cover and the resultant approximate impacts on the extent and volume of waste material that would need to be regraded will be considered. Finally, other installation and maintenance issues that may arise will be addressed.

If the initial technology screening evaluation indicates that a GCL-alternate cover is considered potentially implementable, this technology will be subjected to evaluation of its potential effectiveness, implementability and cost. During this phase, the anticipated performance of a GCL-alternate cover would be qualitatively compared to that of the cover specified in the ROD-selected remedy. If these evaluations indicate that a GCL-alternate cover could provide similar effectiveness to the ROD-selected remedy at minimizing infiltration at comparable cost without significant adverse impacts, then a recommendation for consideration of incorporation of a GCL-alternate landfill cover instead of the cover specified in the ROD would be made.

**Deliverables**

1. Interim Deliverable – A brief memorandum will be prepared summarizing the results of the initial screening of the potential implementability of an ET cover and GCL-alternate cover for OU-1. If an ET cover or GCL alternate cover are considered potentially implementable, this memorandum would also include an evaluation of the potential effectiveness, implementability and cost of these covers. If the results of these evaluations indicate that an ET cover and/or a GCL-alternate cover could provide comparable performance at a comparable cost to that of the low permeability cover included in the ROD-selected remedy, a recommendation for development and evaluation of use of an alternative cover design(s) consisting of ET cover and/or GCL-alternate cover as an alternative(s) to the ROD-selected remedy cover system would also be included in this memorandum.

2. SFS revisions – Assuming that the evaluation of ET cover and/or GCL alternate cover technology only entails evaluation of the potential applicability of this technology and does not result in development of new/additional remedial alternatives, the following revisions to the SFS report are anticipated:

    a. Section 4 – Technology Screening to include evaluation of ET and GCL cover technology implementability
        i. Section 4.2 – Identify ET covers and GCL-alternate covers as additional technologies/process options to be evaluated in the SFS



WLLFOIA4312 - 011 - 0136047

ii. Section 4.3 – Include a description of ET cover and GCL-alternate cover technologies
iii. Section 4.4 – either
    1. Identify ET cover and/or GCL-alternate cover technology as technologies that were screened out based on implementability factors, or
    2. Evaluate the implementability of ET cover and/or GCL-alternate cover technologies
iv. Figure 24 – Add evaluation of the technical implementability of ET cover and/or GCL-alternate cover technologies to this figure.
v. Figure 27 – Add evaluation of the anticipated effectiveness, implementability and cost of ET cover technology and/or GCL-alternate cover technology.

In the event that ET cover technology and/or GCL-alternate cover technology are found to be potentially applicable based on the site and waste conditions, there may be a need to develop one or more additional remedial alternatives for detailed analysis in the Supplemental SFS report. Such an effort is not included with the scope of the evaluation of alternative landfill cover designs addressed by this Scope of Work.

**Schedule**

It is anticipated that performance of an initial technology screening of the potential implementability of ET cover and GCL-alternate cover technologies for OU-1 will take approximately six weeks from receipt of EPA approval of this Work Plan. Assuming that an ET cover technology and/or a GCL-alternate cover technology are potentially implementable for OU-1, the technical evaluation of the potential effectiveness, implementability, and cost of such alternative landfill cover designs and preparation of a summary memorandum will take approximately another six weeks time.

Preparation of a Supplemental SFS report that includes the results of the evaluations of ET cover and GCL-alternate cover technologies will be performed once EPA comments on the interim deliverable are received and in conjunction with revisions to the existing SFS report required to address the results of the various other additional tasks EPA has requested.

**References Consulted**

Albright, W. and C. Benson. 2005. Alternative Cover Assessment Program: Report to Office of Research and Development National Risk Management Research Lab Land Remediation and Pollution Control Division. Desert Research Institute and University of Wisconsin, 54 pp.

Carson, David, undated, Geosynthetic Clay Liners in Waste Containment, EPA Office of Research and Development, National Risk Management Research Laboratory.



WLLFOIA4312 - 011 - 0136048

Engineering Management Support, Inc. (EMSI), 2011, Supplemental Feasibility Study, Radiologically-Impacted Material Excavation Alternative Analysis, West Lake Landfill Operable Unit-1, December 16.

Fayer, M. J., 2000, UNSAT-H Version 3.0: Unsaturated Soil Water and Heat Flow Model, Theory, User Manual, and Examples, PNNL-13249.

Gagne, Dennis, P. 2001, Technical Memorandum to Office of Site Remediation and Restoration – Revised Alternative CAP Design Guidance Proposed for Unlined, Hazardous Waste Landfills in the EPA Region I, February 5.

Row, R.K., and Rimal, S. 2008, Ageing and Long-term Performance of Geomembrane Liners, The First Pan American Geosynthetics Conference & Exhibition, March 2 - 5.

Schroeder, P. R., Aziz, N. M., Lloyd, C. M. and Zappi, P. A., 1994, "The Hydrologic Evaluation of Landfill Performance (HELP) Model: User's Guide for Version 3," EPA/600/R-94/168a, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC.

Šimůnek, J., M. Th. van Genuchten and M. Šejna, The HYDRUS-1D Software Package for Simulating the Movement of Water, Heat, and Multiple Solutes in Variably Saturated Media,Version 3.0, *HYDRUS Software Series 1*, Department of Environmental Sciences, University of California Riverside, Riverside, California, USA, 2005.

U.S. Environmental Protection Agency (EPA), 2011, Fact Sheet on Evapotranspiration Cover Systems for Waste Containment, EPA 542-F-11-001, February.

EPA, 2008, Record of Decision – West Lake Landfill Site, Bridgeton Missouri, Operable Unit 1, May.

EPA, 2004, (Draft) Technical Guidance for RCRA/CERCLA Final Covers, EPA 540-R-04-007, April.

EPA, 2002, Assessment and Recommendations for Improving the Performance of Waste Containment Systems, EPA 600/R-02/099, December.

EPA, 2001, Geosynthetic Clay Liners Used in Municipal Solid Waste Landfills, EPA 530-F-097-002, Revised December.

EPA, 1996, EPA Liner Study – Report to Congress, Section 4113(a) of the Oil Pollution Act of 1990, OSWER 9380.0-24, and EPA 540/R95/041, May.

EPA, 1993, Report of Workshop on Geosynthetic Liners, EPA/600/R-93/171, August.

EPA, 1991, Seminar Publication: Design and Construction of RCRA/CERCLA Final Covers, EPA 625 4-91 025, May.

EPA, 1990, Technology Transfer: Seminars - Design and Construction of RCRA/CERCLA Final Covers.

EPA, 1989, Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments, EPA 530-SW-89-047, July.



WLLFOIA4312 - 011 - 0136049

EPA, 1988, Project Summary: Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments, EPA 600/S2-87/097, February.

EPA, 1987, Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments, EPA 600/2-87/097.

Williams, J.R., Wang, E., Meinardus, A., Harman, W. L., Siemers, Mark, and Atwood, Jay, D., 2006, EPIC Users Guide, v. 0509, Texas AgriLife Blackland Research and Extension Center, January.



WLLFOIA4312 - 011 - 0136050